INSTRUMENTATION AND MEASUREMENTS
BE 441/541 (FALL 2020)

Instructor:	Dev Shrestha	(208) 885 7845	devs@uidaho.edu
TA:	Chad Dunkel	(208) 885 5943	cdunkel@uidaho.edu

Meetings: Lecture: (MW) Engineering Physics 425
Zoom: https://uidaho.zoom.us/j/2088857545
8:30-9:20 AM
Lab: (T) JML 76, 10:30 – 1:20 PM (Pre-Scheduled Only)

Office hours: (F) 8:30-9:20 AM (via zoom, same link)

COURSE DESCRIPTION

Instrumentation is a branch of engineering dealing with measurements and controls. Instrumentation requires a range of knowledge from basic science, statistics, advanced math, and engineering design principles. This course gives students a solid foundation on various sensors, electronics, noise filtering, wired and wireless sensor networks and design principles for instrumentation. Students will design, fabricate and test an instrumentation system for a real world application in their area of interest.

Additional projects/assignment required for graduate course. Prerequisite requirements: ENGR 240 and STAT 301. Primarily for advanced engineering students.

EXPECTED COURSE OUTCOME

After taking this course, the students should be able to use standard hardware, electronic components, and software to solve a broad range of instrumentation related engineering problems. They will understand measurement uncertainties, error analysis, sensor selection, signal processing, and noise filtering. The students will be able to design and conduct the experiment as well as analyze and interpret data measured for common physical and biological parameters.

TEXT BOOK

Measurement and Instrumentation Theory and Application – Second edition
By: Allan S. Morris and Reza Langari. **A pdf copy of this book is available to download from UI library**. Additional material to read and watch will be provided as needed.

COVID NOTICE

Due to COVID-19 pandemic, this class is being offered as HyFlex. Students have option to come to class or join the class via zoom. The zoom sessions will be recorded and will be released within a day. Lab classes will be mostly remote. You will be loaned a kit to complete labs at your residence. You may purchase the kit later in the semester to keep. If there is a space issue at your residence, please pre-schedule with instructor to use J.W. Martin Laboratory.

TENTATIVE CLASS SCHEDULE

Date	Discussion	Reference
24-Aug	Introduction, review of basic concepts	Chapter 12, internet, lab instruction, handout
26-Aug	Analog and digital components, digital representation	Handout
31-Aug	Sensor technologies -i	Chapter 13
2-Sep	Sensor technologies -ii	Chapter 14
7-Sep	**Labor Day**	
9-Sep	Intelligent devices	Chapter 10
14-Sep	Instrument types and performance	Chapter 2
16-Sep	Signal conditioning with operational amplifiers -i	Chapter 6, handout
21-Sep	Signal conditioning with operational amplifiers -ii	Chapter 6, handout
23-Sep	Aliasing and analog filtering	Chapter 6, handout
28-Sep	Aliasing and analog filtering	Chapter 6, handout
30-Sep	Making sense of complex numbers	Handout
5-Oct	Fourier transform and digital filtering -i	Chapter 6, handout
7-Oct	Fourier transform and digital filtering -ii	Chapter 6, handout
12-Oct	**Midterm exam**	
14-Oct	Variable conversion -i	Chapter 7
19-Oct	Variable conversion -ii	Chapter 7
21-Oct	Temperature measurement -i	Chapter 14
26-Oct	Temperature measurement -ii	Chapter 14
28-Oct	Sensor calibration	Chapter 5
2-Nov	Strain measurement	Chapter 7, handout
4-Nov	Dynamic system -i	Chapter 2
9-Nov	Dynamic system -ii	Chapter 2
11-Nov	Statistical analysis of measurements - i	Chapter 4, handout
16-Nov	Statistical analysis of measurements - ii	Chapter 4, handout
18-Nov	Statistical analysis of measurements - iii	Chapter 4, handout
23-Nov	**Fall recess**	
25-Nov	**Fall recess**	
30-Nov	Analog to digital conversion	Handout/web
2-Dec	Sensor selection for various measurements-i	Handout/web
7-Dec	Sensor selection for various measurements-ii	Handout/web
9-Dec	Project review and feedback	

LAB SCHEDULE

Date	Title
25-Aug	1: Introduction to LabVIEW programming
1-Sep	2: Analog and digital circuits
8-Sep	3: Introduction to a microcontroller
15-Sep	4: Integrating LabVIEW and Arduino
22-Sep	5: Serial communication I (RS 232)
29-Sep	6: Serial communication II (SPI and I2C)
6-Oct	7: Signal conditioning with operational amplifier
13-Oct	8: Aliasing and analog filtering
20-Oct	9: Fourier transform and digital filtering
27-Oct	10: Temperature measurement
3-Nov	11: Strain measurement
10-Nov	12: Dynamic measurement
17-Nov	13: Statistical analysis of measurements
24-Nov	Fall recess (no class)
1-Dec	Project work
8-Dec	Final project presentations

The laboratory reports are due the following week. The lab report templets are provided. Other details will be discussed on the class.

GRADING:

Class Attendance/participation	10%
Laboratory Reports	30%
Course Project + Report	20%
Homework	20%
Midterm Exam	20%
Final Exam	No Final Exam

COURSE PROJECT:

A course project will entail designing, building and demonstrating a sensor system. Report writing will follow Transactions of the ASABE journal style.

Disability Support Services Reasonable Accommodations Statement:
Reasonable accommodations are available for students who have documented temporary or permanent disabilities. Please notify your instructor(s) during the first week of class regarding accommodation(s) needed for the course. All accommodations must be approved through Disability Support Services located in the Idaho Commons Building, Room 306.

BE 541

In order to earn graduate credit (BE 541), graduate students must also complete a project that included detailed experimental design, and in-depth analysis. Consult your instructor for acceptable level of details.

Healthy Vandals Policies

It is a longstanding tradition that Vandals take care of Vandals, and we all do our best to look out for the Vandal Family. These simple precautions go a long way in reducing the impact of coronavirus on our campuses and in our communities. With everyone engaging in these small actions, we can continue to participate in our vibrant campus culture where we are able to learn, live, and grow. Please bookmark the University of Idaho Covid-19 webpage and visit it often for the most up-to-date information about the U of I's response to Covid-19.

1. **Daily Symptom Monitoring and In-Person Class Attendance.** Evaluate your own health status before attending in-person classes and **refrain from attending class in-person if you are ill, if you are experiencing any of the known symptoms of coronavirus, or if you have tested positive for COVID-19 or have been potentially exposed to someone with COVID-19**.

    - If you display symptoms and/or test positive, you should quarantine following the CDC's recommendations. Do not return to class until you meet the CDC's requirements.

    - If you have been exposed but are asymptomatic, you should stay home for 14 days from last exposure if you remain asymptomatic, adhering to the CDC's requirements.

    If you miss an in-person class session, you may be able to attend via Zoom and access course materials on BbLearn. Documentation (a doctor's note) for medical excuses is not required; instead, email me to make arrangements to submit any missed work and make plans to use Zoom and/or online course materials to stay current with the course schedule.

2. **Face Coverings.** All faculty, staff, students and visitors across all U of I locations must use face coverings whenever in any U of I buildings. **You are required to wear a face covering over your nose and mouth in this classroom at all times**.
    a. If you have a medical condition that you believe affects your ability to comply with the face covering policy, please contact the Center for Disability Access and Resources (CDAR) to request a reasonable accommodation.
    b. If you have other reasons you believe make you exempt from wearing face coverings, please contact the Covid-19 Coordinator at covid19questions@uidaho.edu.
    c. Failure to wear a face covering means you will be required to leave the classroom. If a disruption to the learning experience occurs due to repeated offence and/or egregious behavior, it will be referred to the Dean of Students Office for potential code violation.